Credit: I Iguchi/UNEP/Topfoto

3.4 Forests

Much of the Earth's above ground biomass and biodiversity is held within its forests. Forests are sources of food, fuel, construction materials, fibers, and biological diversity. Forests are also important in water and air filtration, carbon sequestration, soil stabilization, and tourism (Williams 1994, 1990). It has been estimated that roughly three-fourths of a hectare of forestland is now needed to supply each person on the planet with shelter and fuel (Lund and Iremonger 1998).

Around the globe, there are a number of different types of forests. They are classified according to a scheme that is largely determined by climate and landform and that distinguishes evergreen and deciduous forests as well as broadleaf and needle-leaf forests.

Deciduous broadleaf forests, for example, tend to be found in temperate zone regions that have distinct seasons and moderate precipitation. Lowland deciduous broadleaf forests—a source of great biodiversity—also tend to grow on soils considered to be highly suitable for agriculture. Consequently, many of the lowland forests in the Northern Hemisphere have been cut down and the land they once occupied converted to cropland. Lowland forests are currently facing the same fate in South America and Africa.

Evergreen broadleaf forests— often called "rain forests"— tend to occur in tropical climates with high levels of precipitation. Deciduous needle-leaf forests occupy regions with climates characterized by severe temperature variations such as eastern Siberia, a region with extremely cold winters and the Sahel, a region with extremely hot, dry summers. Evergreen needle-leaf forests occur throughout polar, temperate, and subtropical regions. Mixed forests occupy transition zones. Swamp forests and mangroves exist in areas where soils are saturated, or even inundated with fresh water or ocean water, respectively.

Like any type of ecosystem, forests undergo changes, both natural and human-induced. Attempts to determine how forests have changed over time, however, are often complicated by the fact that there is no single definition as to what constitutes a "forest." Land parcels may be classified according to their cur-

Several different terms are often associated with forests and the changes they may undergo. *Deforestation* is the removal of tree cover and the conversion of the resulting deforested land to some other use. *Reforestation* refers to re-establishing tree cover on previously forested land. *Afforestation* is the creation of forest cover where it did not previously exist or where it existed only in the distant past. *Forest degradation* refers to changing a forest to such a degree that the species that inhabit that forest can no longer compete for survival; degradation typically leads to long term changes in species composition.

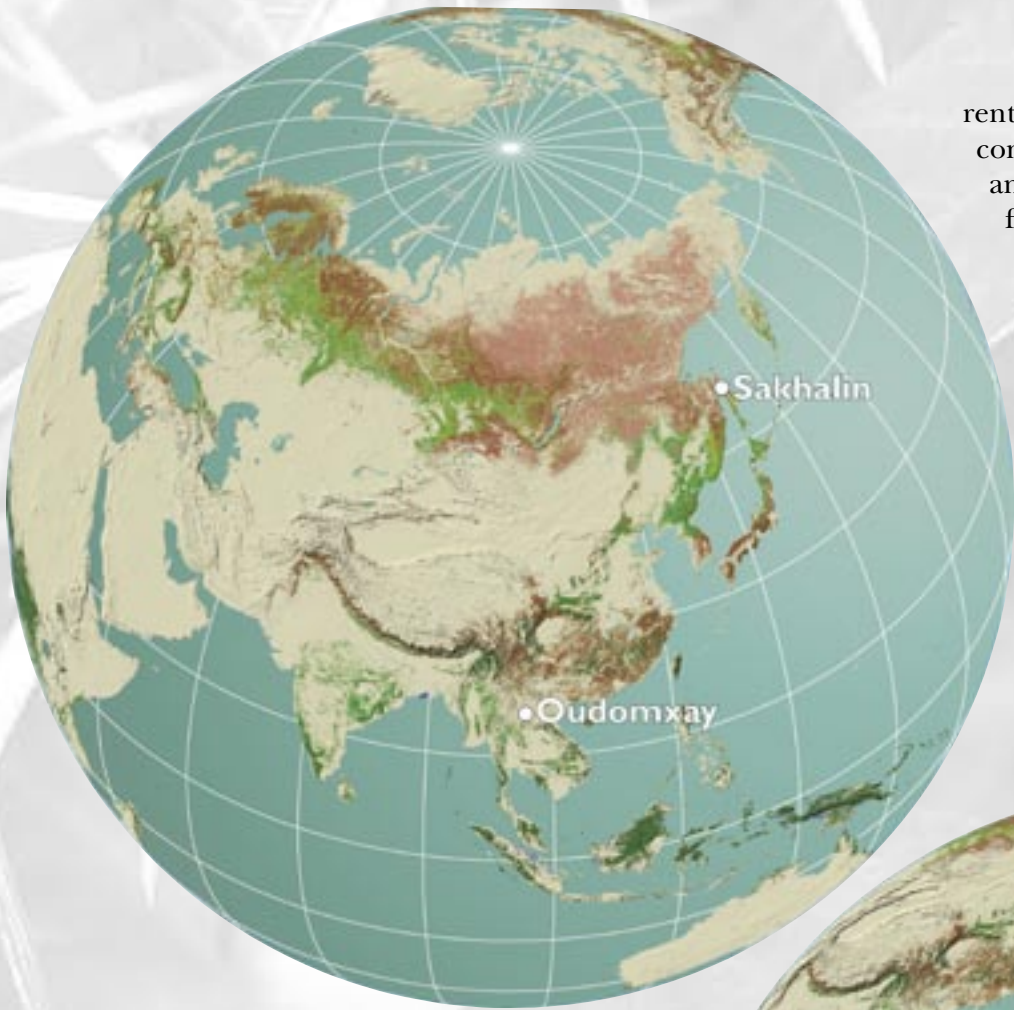
rent land cover, potential land cover, current use, administration, or a combination of these criteria (Lund 2002). The United Nations Food and Agriculture Organization (FAO), which is responsible for global forest resource assessments, classifies "forests" using a definition that combines both land cover and use (FAO 2001). This can lead to some lands that are without trees due to fires or clear-cutting activities being classified as "forest," while other lands that are covered with trees, such as orchards and coffee plantations, are classified as agricultural land or croplands rather than forests.

Despite such caveats, it is clear that there have been significant changes over time in the character and spatial distribution of forests worldwide. It is estimated that about 8 000 years ago, forests occupied some 6 200 million hectares (15 320 million acres), or approximately 50 per cent, of the Earth's land surface (Bryant et al. 1987). Today, less than 4 000 million hectares (9 884 million acres), or 28 per cent, of that total remains (FAO 2001). This reduction in forest cover continues. From 1990 to 2000, the global net rate of deforestation was approximately 94 000 km^2 (36 294 square miles) per year. (This figure represents a gross loss of some 123 000 km^2 (47 491 square miles) of forest per year offset by a net gain, through reforestation or afforestation, of roughly 29 000 to 30 000 km^2 (11 197 to 11 583 square miles) of forest per year.)

Fires are a natural event in most ecosystems, including forests. Fires are often used to clear land on forest margins; occasionally, fires are employed to bring about a change in land use. Sometimes fires are simply the outcome of increasing numbers of people coming into contact with forests. Most forestland disappearance is attributable to conversion to pasture, cropland, or urbanization. Forest ecosystems are also degraded by fuel-wood collection and the grazing of cattle and other livestock.

Gains in forest area come from afforestation projects, reforestation, fire suppression, and the abandonment of croplands. A major concern of conservationists is the conversion of native forests to tree plantations. The conversion to monocultural tree plantations is particularly harmful to the biodiversity of the original, natural forest ecosystem.

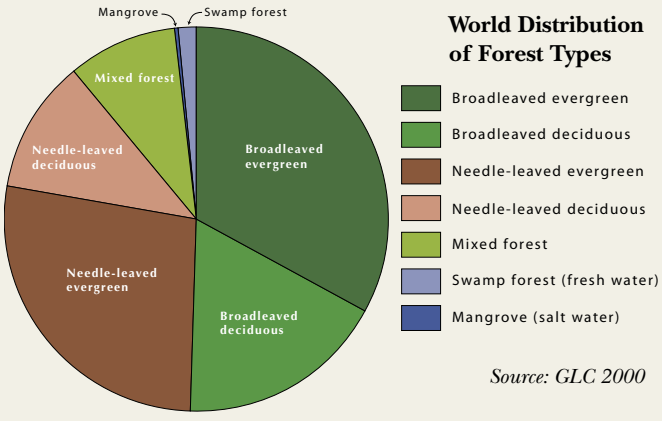
Approximately 12 per cent of the world's forests are protected. But this protection is unevenly distributed around the globe. It is estimated that one hectare of natural, once-inaccessible forest in Asia, South America, Africa and the former Soviet Union is lost for every 20 hectares (49 acres) of forest set aside and protected in North America and Europe (Sohngen et al. 1998). Just how well these forests are protected over ecologically significant time scales



Forests

- Broadleaved evergreen
- Broadleaved deciduous
- Needle-leaved evergreen
- Needle-leaved deciduous
- Mixed forest
- Swamp forest (fresh water)
- Mangrove (salt water)

Source: Global land cover 2000 (GLC 2000)



Source: GLC 2000

is also a continuing issue. The historical trend is for people to continue to convert more and more of any forested landscape for other uses. Often, these converted lands end up as low-grade pasture, with the result that forest ecosystems are destroyed for what amounts to only transient economic or social benefit. Unfortunately, this trend is likely to continue until either the human population stabilizes or demands for forest goods and services become sustainable—or both.

Whatever the future holds, many of the images in this section show the profound effect that humans have had, and continue to have, on the Earth's forests.

Forest Fire

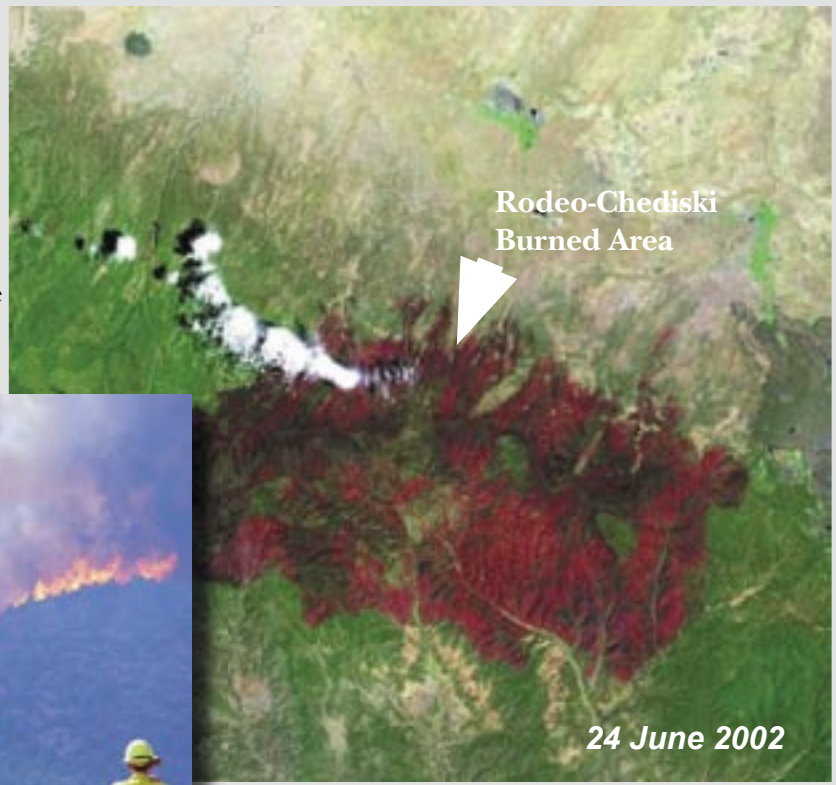
Wildfires can have both positive and negative effects on the environment. In some ecosystems, fires play an ecologically significant role in maintaining biogeochemical cycles. The biological diversity of plant and animal life in the world's forests, prairies, and wetlands partly depends on the effects of fire. Some plants, for example, cannot reproduce without fire; intense heat is needed to open cones or rupture seed coats so that seed dispersal and germination can take place. Fires naturally shape many types of ecosystems including the boreal forests of Canada, Alaska, and Russia and the chaparral in southern California.

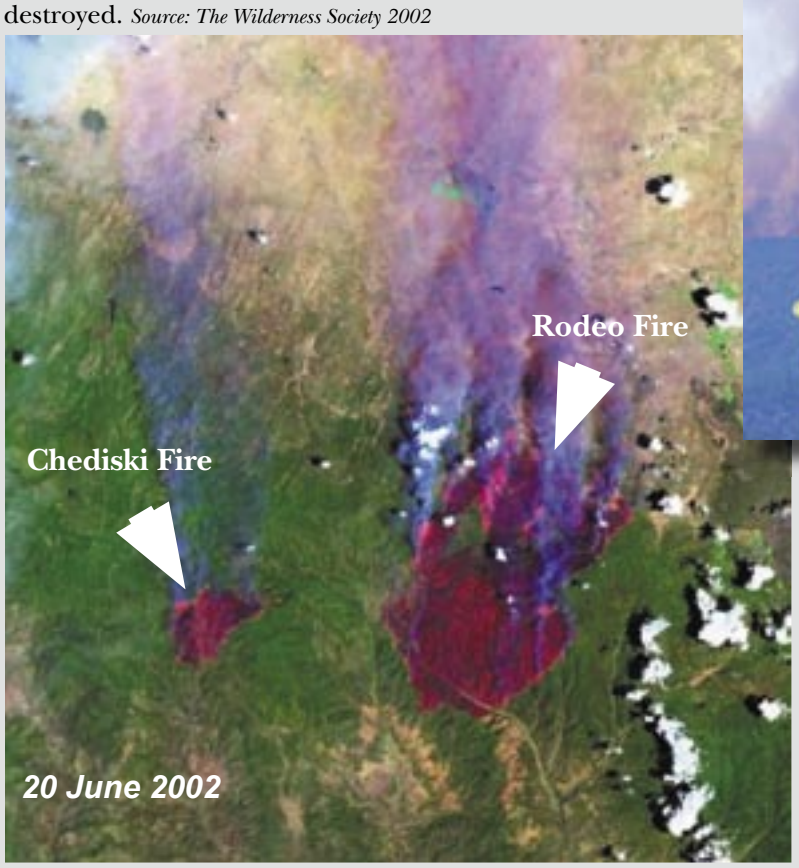
In addition to "natural" fires, people have used fire for thousands of years to clear land. Whether caused by nature or by people, wildfires are a significant force for environmental change, one that can radically alter a landscape in a very short time (see box below).

The Earth's burgeoning human population, coupled with intensified economic development, has led to the serious degradation of many of the world's forests. Degraded forests are often highly

Case Study: Rodeo-Chediski Fires 2002

On the afternoon of 18 June 2002, a fire broke out near the Rodeo Fairgrounds on the Fort Apache Reservation in Arizona. By mid-morning on 20 June, the so-called Rodeo fire had expanded to 12 000 hectares (30 000 acres). Meanwhile, a second blaze began burning near Chediski Peak about 24 km (15 miles) from the Rodeo fire, where a lost hiker had started a signal fire. Two days later, on 24 June, the two fires merged to encompass more than 94 000 hectares (235 000 acres). Over the subsequent two weeks, the fire burned an additional 80 000 hectares (200 000 acres), making it the largest, most severe wildfire in Arizona. Before the blaze was brought under control, over 30 000 people were evacuated and 400 homes were destroyed. *Source: The Wilderness Society 2002*





Credits: Unknown/UNEP/USDA Forestry Service

The 20 June 2002 satellite image-pictured left shows the Rodeo and Chediski fires burning seperately. The 24 June 2002 image above shows the burned areas of the the Rodeo-Chediski fire. Areas where fires were burning when the images were captured appear bright red; already burned areas have a darker red coloration. *Source: USGS 2002, NASA 2002*

Credit: UNEP/NASA

susceptible to fire. Logging and large-scale land clearing, for example, disturb the microclimate of forest ecosystems, increasing their fuel load and thus the potential intensity of resulting forest fires. Changes in the Earth's climate, characterized by extended droughts, higher global surface temperatures, and more violent thunderstorms, hurricanes and other types of severe weather, can further intensify the risk of forest fires (Remote Sensing Services GmbH 1998). Concomitantly, fires themselves may play an important role in climate change by emitting both greenhouse gases and smoke particles (aerosols) into the atmosphere.

In 2000, more than 350 million hectares (865 million acres) of forest were burned worldwide—an area equal to the size of India (Northoff 2003). However, when fire sweeps through a forest, many of the trees may survive. In some cases, the fire may burn only the low-growing vegetation.

Amazon Forests and Fire

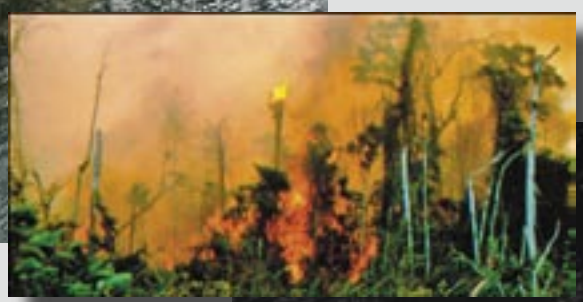
Before widespread human settlement began to encroach on the borders of South America's Amazon forests, there was no such thing as an Amazon fire season. Now, fire may pose the biggest threat to the survival of the Amazon forest ecosystem.

Slash-and-burn agriculture converts forest to farmland, but that obvious destruction is only the beginning. Intentionally set fires often expand out of control and burn through the understory in areas of surrounding forest, killing, but not completely burning small trees, vines and shrubs. The dead and dying trees collapse, spilling firewood and kindling to the ground and creating openings in the forest canopy. Logging has a similar effect. The intense tropical sun, previously deflected by the green canopy, heats the forest floor, pushing fire danger even higher. In this damaged, fragmented landscape, the onset of the natural dry season brings with it an ominous threat of fire. That threat grows even greater when El Niño-driven droughts occur several times per decade.

Case Study: Pará, Brazil
2004

Once extremely rare even during dry seasons, fire is now a common occurrence in the Amazon rain forest as people use it as a land management tool. Although land management fires may not be immediately hazardous, it is not uncommon for them to escape control and become considerably more destructive. Forest fires can also impact weather, climate, human health, and natural resources.

These two satellite images show an area of the rain forest in the state of Pará, Brazil, at the point where the Tapajós River (angling up from the bottom of each image) joins the Amazon River (running across each image). In this region, forested land is being cleared for logging, ranching, and farming. Cleared areas are visible along the river banks, extending into the forest. Deforested areas appear light green, while undisturbed forest is dark green.



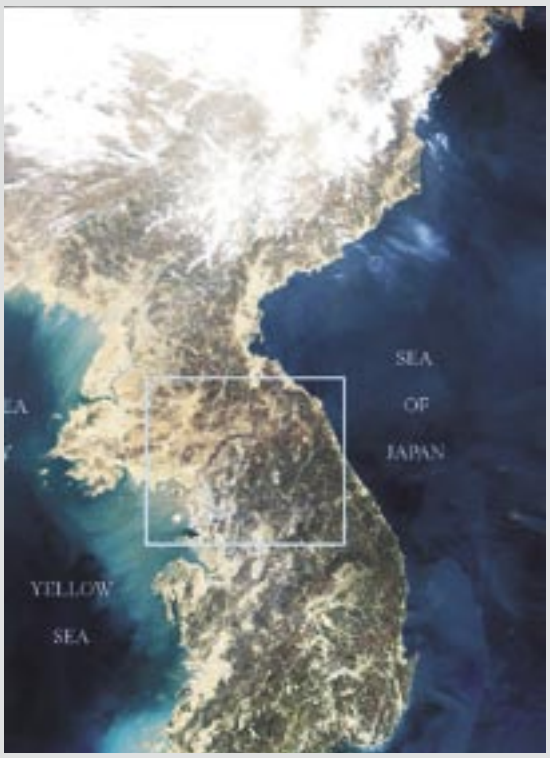
The image dated 18 November 2004 reveals the locations of a number of fires (red dots) burning in different parts of the forest. Roughly three weeks later, fires are still burning and the entire scene has a hazy appearance, the result of smoke suspended in the air over the forest. Fires burned off and on in this region for more than a month.
Source: NOAA 2004

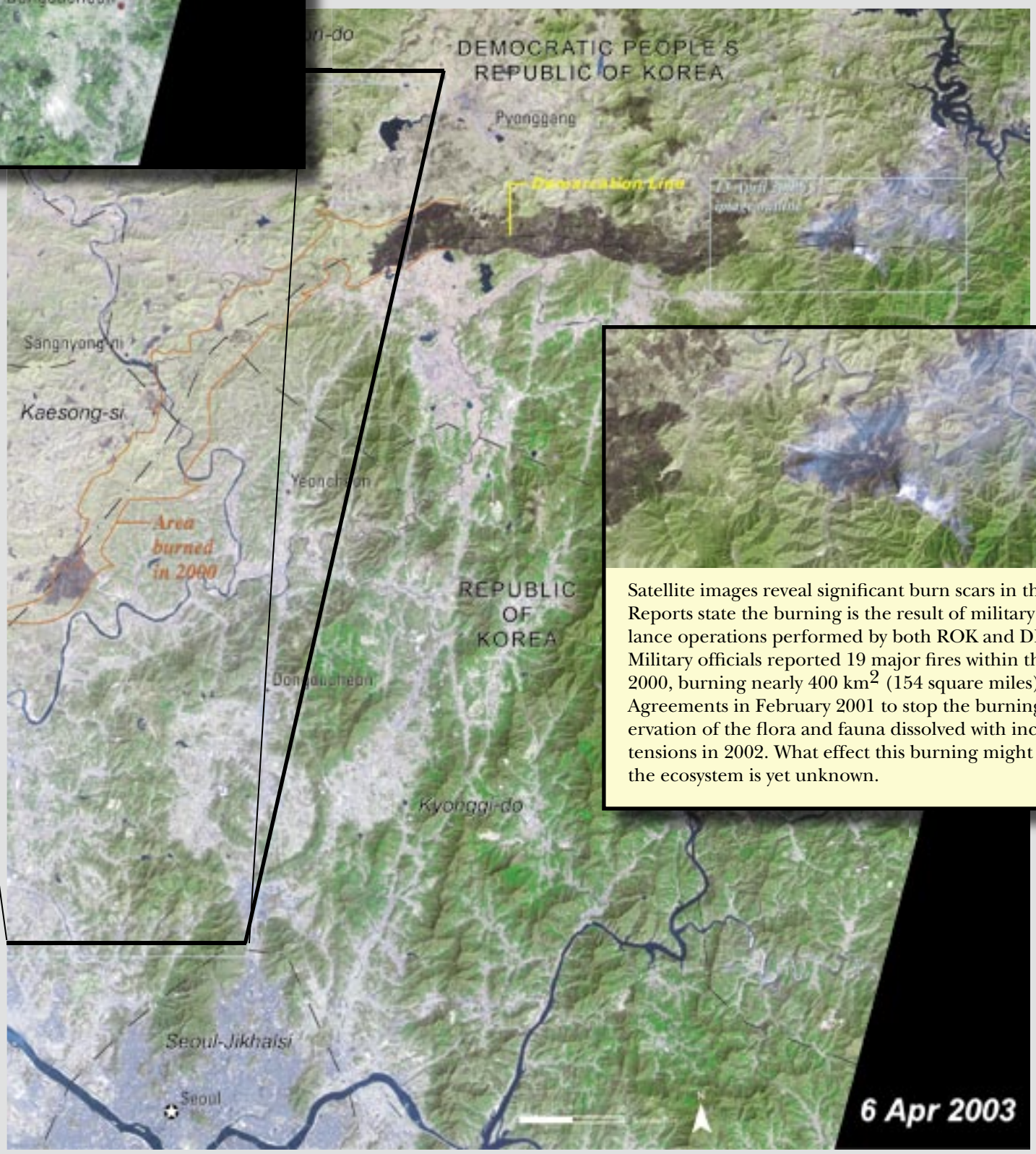
Credits: Unknown/UNEP/NASA

Case Study: Demilitarized Zone

The Korean Demilitarized Zone (DMZ), which separates the Republic of Korea(ROK) to the south and the Democratic People's Republic of Korea (DPRK) to the north, represents an opportunity to preserve an environment relatively untouched by humans since the UN established the political buffer in 1953.

The DMZ contains five rivers, and many ecosystem types: forests, mountains, wetlands, prairies, bogs, and estuaries. In 2001, the ROK government completed a six year study of the ecosystem in the DMZ, the 250-km-long (155-mile-long), 4-km-wide (2.5-mile-wide) no-man's land that separates the Korean Peninsula. It houses some of the world's rarest species of flora and fauna. South Korean officials began pushing ahead with a project to register part of the DMZ with UNESCO as a Transboundary Biosphere Reserve (TBR). The idea of a nearly 100 000 hectares (247 105 acres) preserve in such a location is quite intriguing and unique.

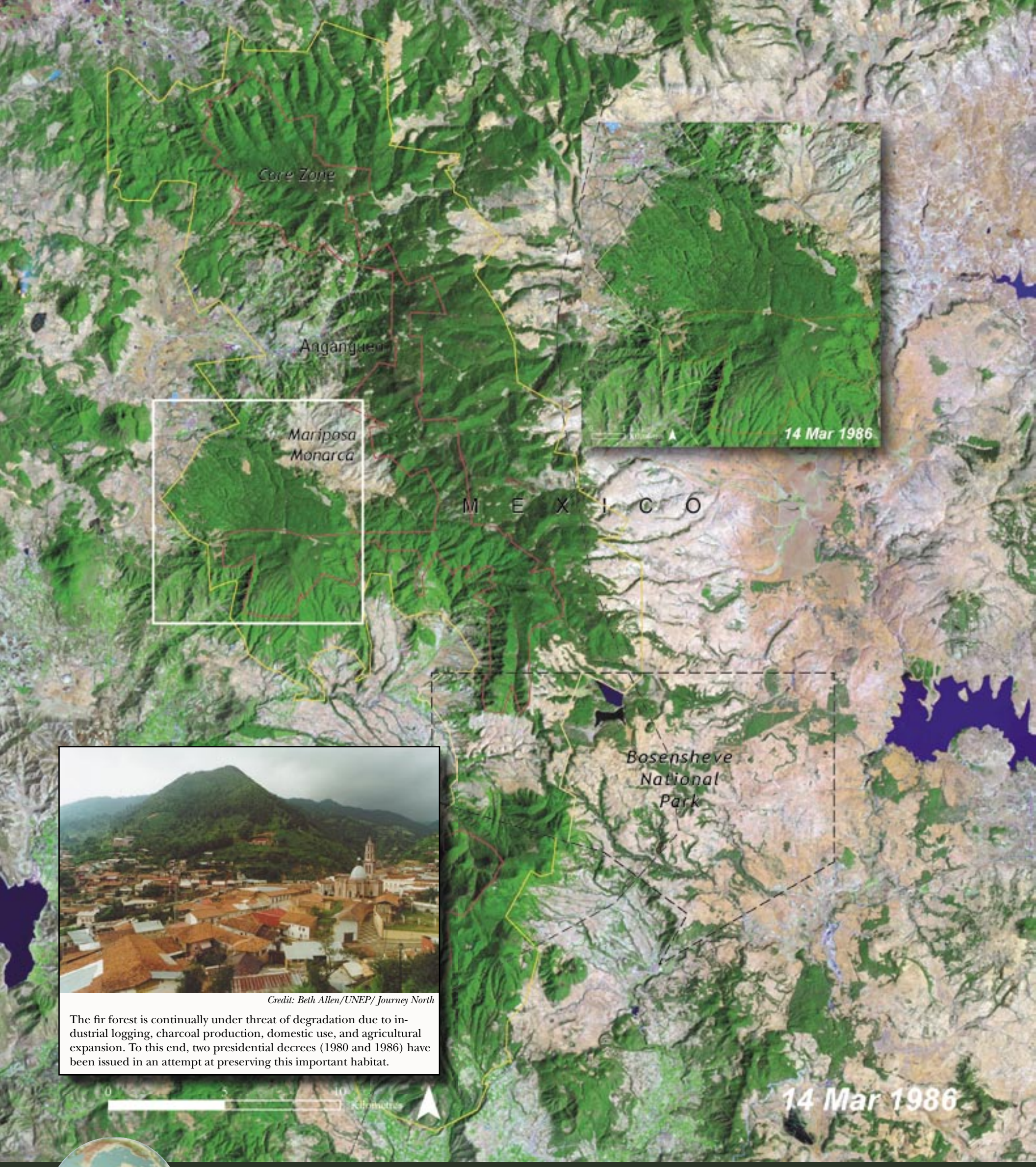




Satellite images reveal significant burn scars in the DMZ. Reports state the burning is the result of military surveillance operations performed by both ROK and DPRK. Military officials reported 19 major fires within the DMZ in 2000, burning nearly 400 km^2 (154 square miles) of land. Agreements in February 2001 to stop the burning for preservation of the flora and fauna dissolved with increased tensions in 2002. What effect this burning might have on the ecosystem is yet unknown.

A detailed look on 13 April 2000 (upper left), reveals burn scars as black areas in the Korean DMZ. It appears that the area has been burned on both sides of the border, probably for military surveillance purposes. Areas burned in 2000 have blended once again with the surrounding landscape, but new burns actively clear vegetation to the north and east.

Credit: Carrie E Gran/UNEP/Topfoto



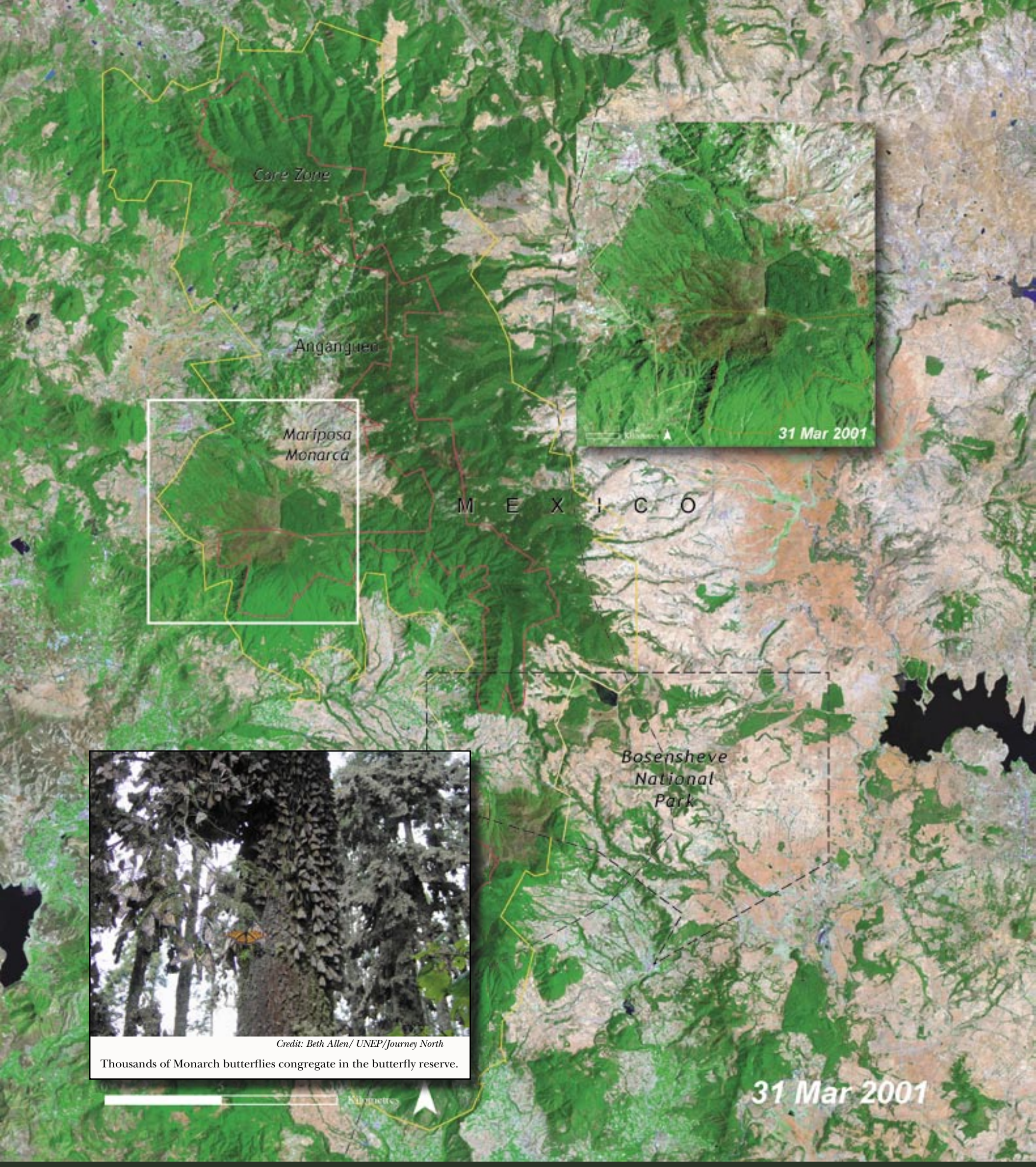
Credit: Beth Allen/UNEP/ Journey North

The fir forest is continually under threat of degradation due to industrial logging, charcoal production, domestic use, and agricultural expansion. To this end, two presidential decrees (1980 and 1986) have been issued in an attempt at preserving this important habitat.

Subtropical Forest

Angangueo, Mexico

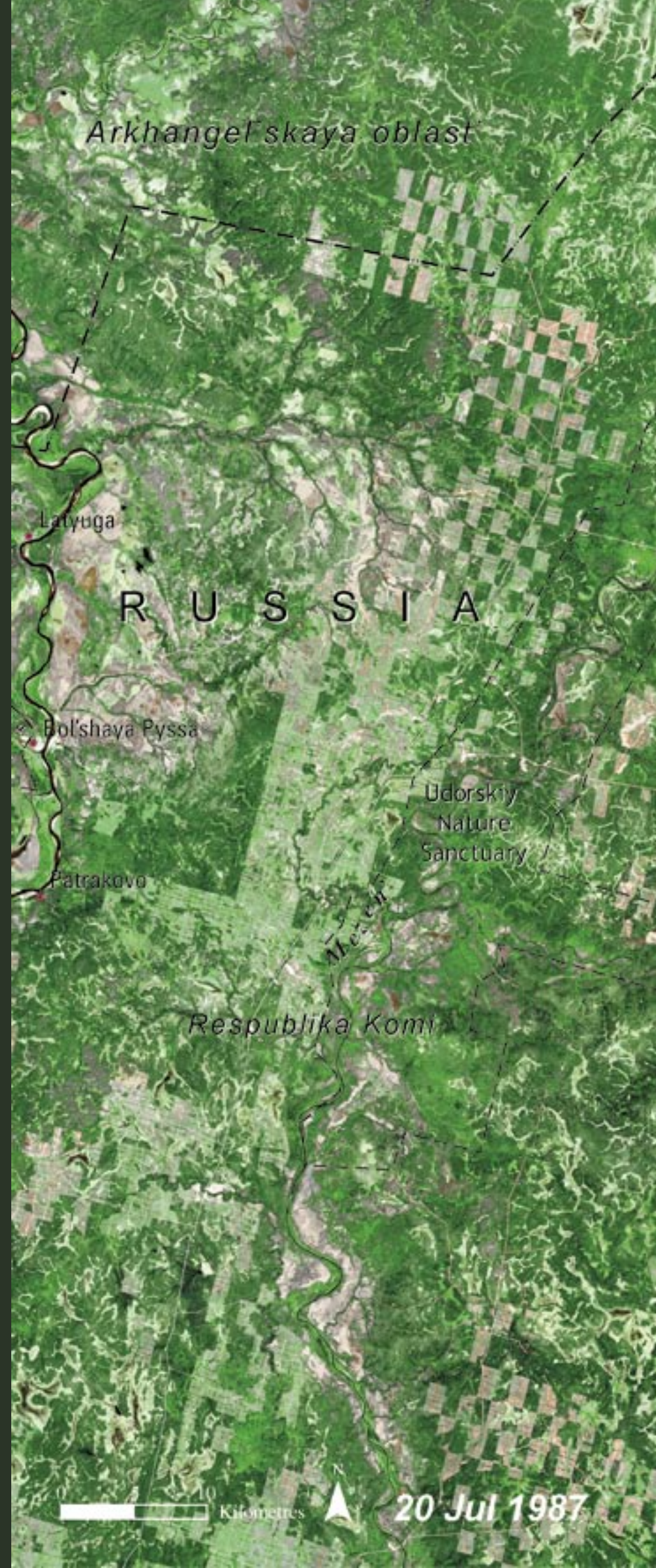
The oyamel fir forest of Angangueo, central Mexico, is an important habitat for wintering monarch butterflies. Because this forest occurs within the tropics at high elevation, it provides a relatively stable microclimatic



Credit: Beth Allen/ UNEP/Journey North

Thousands of Monarch butterflies congregate in the butterfly reserve.

envelope that protects the butterflies from freezing on cold nights during the five month overwintering season. Adiabatic rainfall together with fog condensation on the fir and pine boughs provides the moisture that prevents the butterflies from desiccating as the dry season advances. A comparison of the 1986 image to the 2001 image reveals that parts of the forests have been degraded severely. The two close-up images serve to illustrate the most affected areas. In these images, the unaffected forest is green in colour while the degraded area is tan. It is estimated that between 1984 and 1999, 38 per cent of the forests protected by two presidential decrees were degraded.



Boreal Forest

Arkhangelsk, Russia

The Arkhangelsk region is situated in northwestern Russia, where its 3 000-km (1 158-mile) coastline is washed by the icy waters of three Arctic seas; the White, the Barents and the Kara. The area's proximity to the ocean contributed to its early settlement and subsequent development.

Credit: Fred Wohlert/UNEP/Topham

Mining activities and petroleum refineries are major sources of air pollution in northern boreal forests, including those of the Arkhangelsk region.

Credit: David P. Shorthouse/UNEP/Forestry Images

The Arkhangelsk region has suffered from severe forest degradation.

The Arkhangelsk region was once cloaked with dense boreal forests. In comparing these three satellite images, however, the widespread forest cover disturbance is obvious. In some places, large sections of the forest have been clear-felled and the trees completely removed. Other places show a block pattern, where sections of relatively undisturbed forest are left between clear-felled sections to enhance reseeding and reforestation. In a number of areas, networks of minor access roads delineate the forest cover. The region is also home to the Plesetsk Space Center and has been impacted by fire and pollution from falling rocket stages. Overall, forest cover in the Arkhangelsk has been heavily disturbed—even within areas designated as nature sanctuaries.

Logging in British Columbia

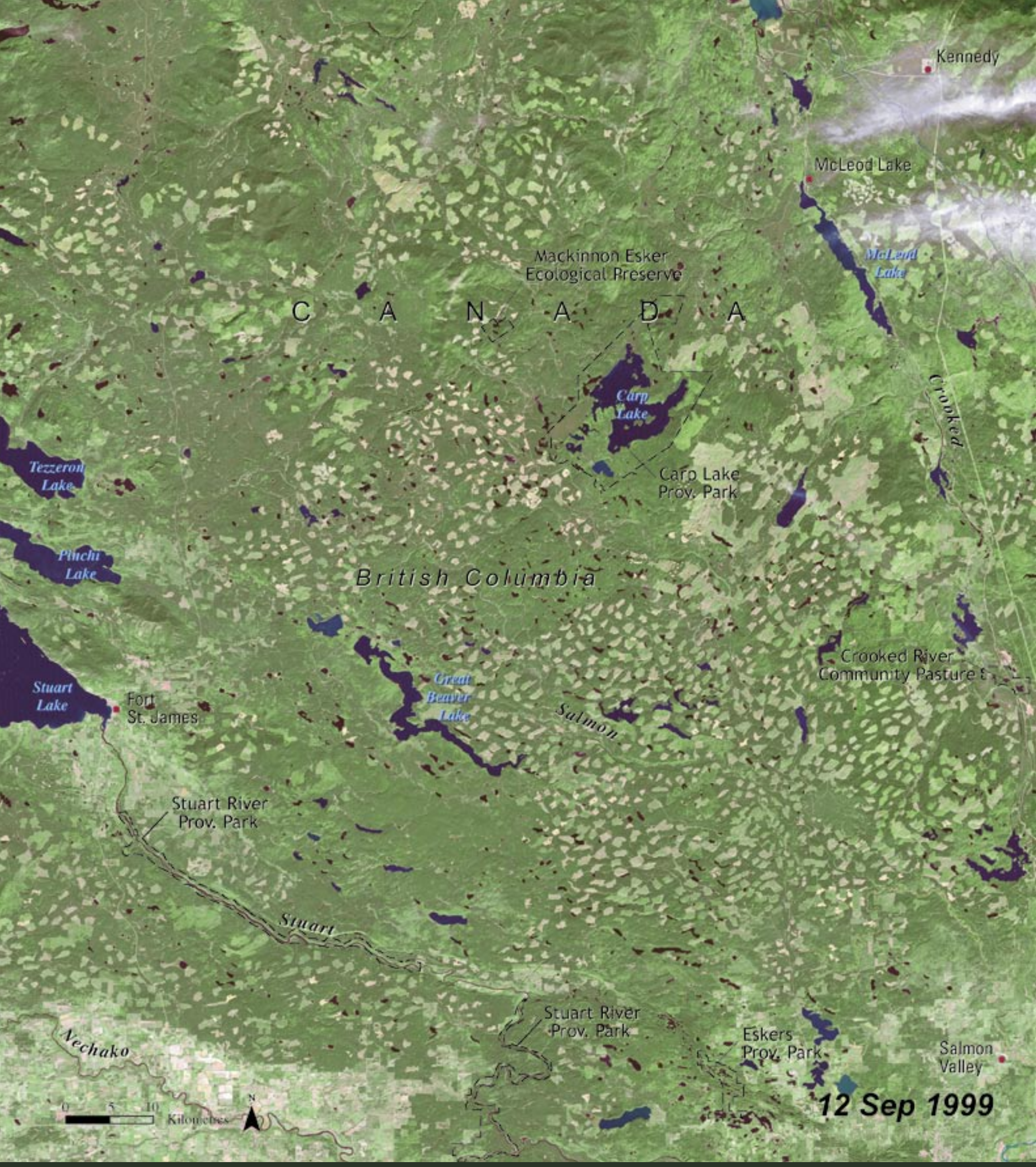
Credit: Rick Collins/UNEP/Topham

Kennedy
McLeod Lake
McLeod Lake
Mackinnon Esker Ecological Preserve
C A N A D A
Carp Lake
Carp Lake Prov. Park
Crooked
Tezzeron Lake
Pinchi Lake
British Columbia
Stuart Lake
Fort St. James
Great Beaver Lake
Salmon
Crooked River Community Pasture
Stuart River Prov. Park
Stuart
Stuart River Prov. Park
Eskers Prov. Park
Salmon Valley
Nechako
0 5 10 Kilometres
N
3 Jun 1973

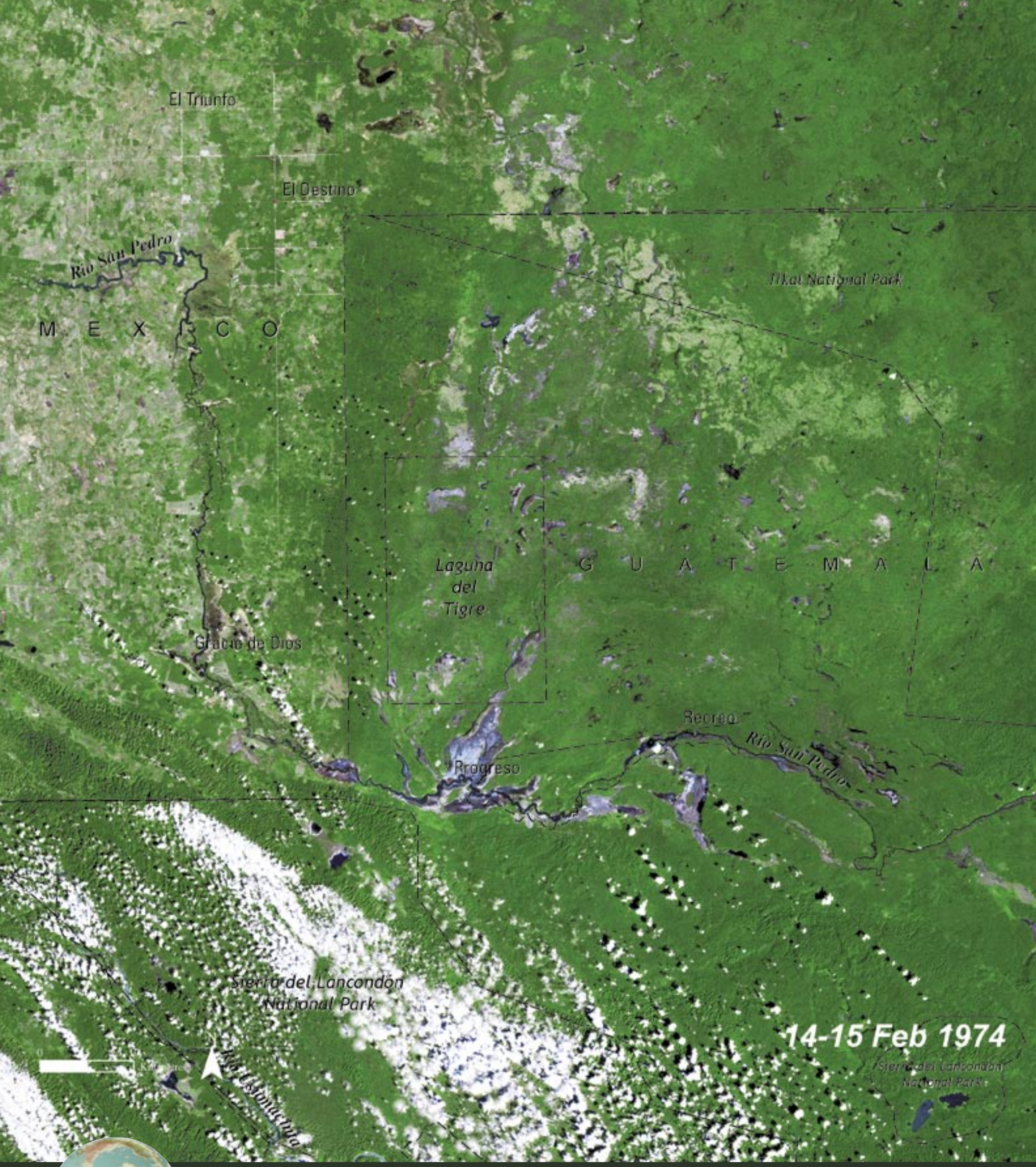
Temperate Forest

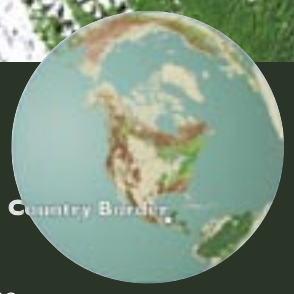
British Columbia, Canada

Temperate forests tend to be found in mid-latitude areas and are characterized by well-defined seasons with warm summers and cold winters, with precipitation that is sufficient for tree growth. The same regions of the world in which temperate forests occur are also home



to large numbers of people. As a result, temperate forests constitute one of the most altered biomes on the planet. Only scattered remnants of the Earth's original temperate forests remain today, some of which still contain stands of trees that are in high demand for their valuable wood. The interior of British Columbia is a perfect example. Logging is a major industry in British Columbia, carried out almost exclusively in virgin forest, which is very rich in endemic biodiversity. This pair of satellite images of the Fraser River Valley in British Columbia shows the impact of logging and other human activities during a period of about 25 years, from 1973-1999. The heavy exploitation of the forest is evidenced by the "patchwork quilt" appearance that is typical of logged-over areas.





Tropical Forest

Country Border, Guatemala/Mexico

The border between Guatemala and Mexico runs through Mexico's Chiapas Forest and Guatemala's El Peten. In this pair of images, the border is easy to see,

even without the black lines that have been overlaid on the images to show the outlines of the two countries.

The region crossed by this border was once biologically very diverse. On the Guatemalan side, it still is, as most of the El Peten remains as closed canopy forest because of lower population densities and the protected status of the Sierra de Lacondon and Laguna del Tigre National Parks. Across the border in Chiapas, however, a larger and increasing population has an obvious effect on the landscape. Between 1974 and 2000, much of the forest on the Mexican side of the border has been converted to cropland or pasture.

BRAZIL

Itaipú Dam

Ciudad del Este

Foz do Iguaçu

Iguaçu (Iguazú)

Puerto Iguazú

Iguazú Falls

PARAGUAY

Paraná

ARGENTINA

23 Feb 1973

Credit: John Townshend/UNEP

Sparsely populated during the 1970s, this region has undergone major development and large areas of forest have been converted to agricultural lands.

Subtropical Forest

Iguazú, South America

Iguazú National Park, located in Argentina near its borders with Brazil and Paraguay, contains remnants of the highly endangered Paranaense Rain Forest. Isolated from other rain forests by natural barriers, the Paranaense developed a distinct and highly diverse ecosystem with

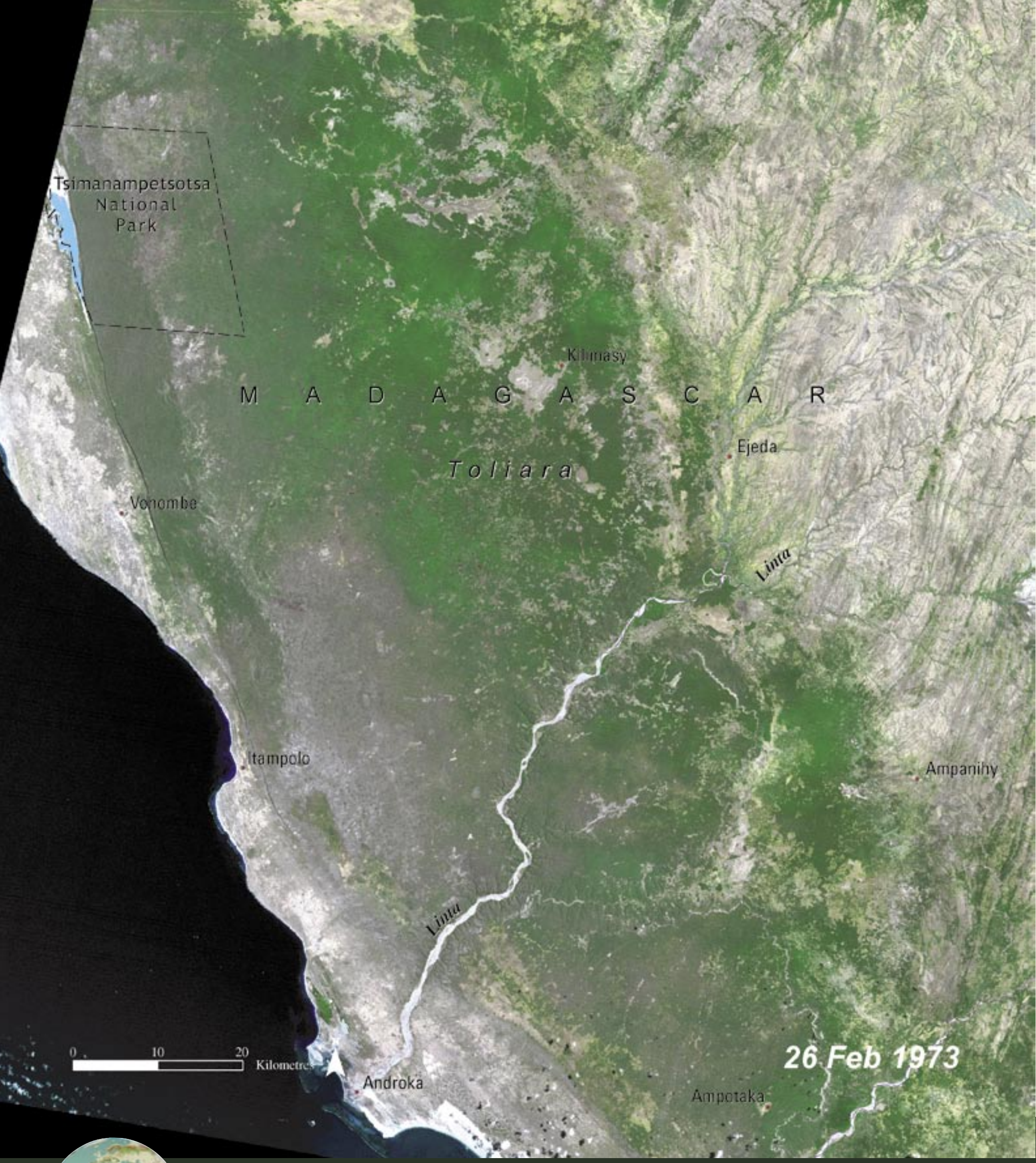
Credit: IKONOS/UNEP/SpaceImaging
Itaipú Dam, one of the world's largest, was built from 1973 to 1982 and is a major source of electricity for both Brazil and Paraguay.

Credit: Teal H.F. Smith/UNEP
One of the many falls within Igauzú National Park

Credit: John Townshend/UNEP
Over 90 per cent of the Paranaense Forest has been converted into agricultural fields, in which mainly soybeans and corn are grown.

thousands of species of mammals, birds, reptiles, and amphibians unique to the area. The famous Iguazú Falls are located within the boundaries of the National Park and are shared by Argentina and Brazil.

Between1973 and 2003, dramatic changes to the landscape occurred in this region. In 1973 the forested area spread across the borders of the three nations. By 2003, however, large areas of the forest in Paraguay and Brazil, and smaller amounts in Argentina, had been converted to other forms of land cover, creating a mosaic of differently colored land use areas. Note the variation in land cover patterns among the different countries—reflections of different land use polices and practices.



Subtropical Forest

Itampolo, Madagascar

Madagascar is the world's fourth largest island and has been described as an "alternative world" or a "world apart" because of its unique and rare plant and animal species. Madagascar was once

almost completely forested. But the practice of burning the forest to clear land for dry rice cultivation has over time denuded most of the landscape, particularly in the central highlands (tan colour in the 2001 image). Coffee production, grazing, gathering fuelwood, logging, cattle ranching, mining and other activities also have contributed to deforestation and land degradation. This set of satellite images shows a narrow coastal plain near the Linta River of southwestern Madagascar. Between 1973 and 2001, the forests in this area have all but disappeared. Remarkably, numerous endemic species still remain in scattered forest remnants.

Mugwambuli

Tshopo

Congo

Kisangani

DEMOCRATIC REPUBLIC
OF THE CONGO

Boat on the Congo River
Credit: Lumbuenamo Raymond/UNEP

0 5 10 Kilometres

N

15 Jan 1975

Tropical Forest

Kisangani, D.R. of the Congo

Kisangani, in the Democratic Republic of the Congo, is located along the Congo River in the northwestern part of the country. It is a city of roughly a half million people.

In these images, most of the region

Aerial view of Kisangani

Credit: Lumbuenamo Raymond/UNEP

around Kisangani is a rich green colour, indicative of dense forest cover. However, directly around the city is a light green zone—evidence of deforestation and conversion of the land to other uses. In the second image, taken in 2001, the cleared area around the city has grown and become consolidated; it has also spread along the rivers and the roads. Much of the deforestation is attributed to the influx of refugees into the country. Even the denser parts of the forest, once thought to be impenetrable, show signs of deforestation.

RUSSIA

Girvasskiy Nature Sanctuary

Urho Kekkosen Kansallispuisto National Park

F I N L A N D

Iappi

Tulppio

Drainage of peat lands enables trees to grow.
Credit: H. Gyde Lund/UNEP

Värriön Luonnonpuisto State Nature Reserve

0 2 4 Kilometres

20 Jul 1987

Tuntsan Erämaa - Alue Wilderness Area

Boreal Forest
Lappi, Finland

Finland is the most forested country in Europe; 86 per cent of its land area, or a total of 26 million hectares (64 million acres), is covered by forest. The country is responsible for one quarter of the world's printing and writing paper exports, and for one sixth of its paperboard

exports. Feeding this massive paper industry is the Finnish forest industry – one of the most intensive in the world. As a result, Finland's forests—including its remaining old-growth fragments—are being exploited by clearcutting, forest thinning, road construction, and ditching of soils. The result is the severe and extensive fragmentation of natural habitat. While much of Finland's productive forest (around 62 per cent) is in the hands of private landowners, the vast majority of its valuable old-growth forest is owned and logged by the state. These two images show a result of this logging in the northeastern areas of the country. In the 1987 image, the area has a near homogeneous forest cover (green); on the other hand, the 2002 image shows only a few patches, mainly in the protected areas with continuous forest cover. The patches of tan signify clearcut areas.

Temperate Forest

Olympic Peninsula, United States

On the slopes and the surrounding areas of Mt. Olympus in the Olympic Peninsula of the Pacific Northwest, one of the last remnants of temperate forests in the United States is quickly disappearing. Between 1971 and 2002, nearly half a million hectares (1.1 million acres), or almost 29

An alpine meadow located in Olympic National Park.

Photo Credit: Unknown/UNEP/US National Park Service

per cent of the forest covering the Peninsula, was clear-cut. That is an area equal in size to the Olympic National Park and its five adjacent wilderness areas.

The 1974 image shows the characteristic patchwork of purple and pink areas where clear-cutting has taken place. Light green patches signify regrowth in the forest areas. On a percentage basis, forests owned by Native tribes on the Peninsula were the most severely impacted during this period of time: 48 per cent of the forests on Native lands were clear-felled. In the 2000 image, clear-cutting is obviously still continuing, as is development to the north, west, and south of the national park. There is evidence of good regrowth of trees in forest reserve areas in preparation for the next clear-felling cycle.

Ban Houalouang

Muang Luong Nam Tha

Sala Mok

Ban Mok Pot

Ban Song Cha

L A O S

Ban Pawi

O u d o m x a y

Nam Beng

Ban Donkeo

Muang Houn

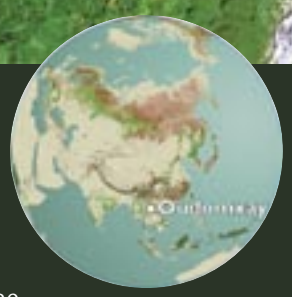
Mekong

0 20 Kilometres

N

26 Nov 1975

Deforestation in the Oudomxay region
Credit: Chandra Giri/UNEP/USGS



Tropical Forest
Oudomxay, Laos

Laos (The Lao Peoples Democratic Republic) is a small land-locked country in Southeast Asia that is rich in forest and water resources. However, human agricultural practices such as uncontrolled

Recently harvested lumber next to a road
Credit: Chandra Giri/UNEP/USGS

burning and shifting cultivation—a land-use pattern in which patches of forest are cleared, burned and cultivated, and then abandoned to allow regrowth and recovery before being exploited again—are the primary causes of deforestation throughout the country. A comparison of these 1975 and 2000 satellite images shows how the intensity of shifting cultivation activities—and the resulting environmental damage—has increased over time. In 1975 there were only scattered areas under cultivation (white patches) in the forest. By 2000, the number and size of cultivated areas and disturbed forest cover had increased substantially.

Tropical Forest
Papua, Indonesia

Indonesia is the second largest producer of palm oil in the world, after Malaysia. The drive to meet the demand for palm oil is resulting in conversion of forested areas into palm oil plantations. These three

Kukurantap

Uvimmerah

Expansion since 2000

Getentiri

Asike

Digul

INDONESIA

Papua

Eiwot

Oil palm fruit in Malaysia

Credit: H. Gyde Lund/UNEP

0 5 10 Kilometres

N

28 Oct 2002

satellite images reveal how a combination of transmigration, logging interests, and palm oil plantation development have transformed an area that was previously tropical lowland rain and swamp forest.

While the 1990 image shows the first signs of development in this region, with the jagged access road network forming the only break in the forest cover, the October 2000 image reveals an area being prepared for palm oil plantations, and evidence of an influx of plantation workers. The 2002 image clearly shows a checkered pattern of plantations in the primary development area, and the extension of the road network to the north, south, and southwest.

This 1989 Landsat image shows substantial immigration to the area between 1975-1986. The predominant "feathered" or "fishbone" pattern illustrates the result of logging operations, providing mechanized access to land resources.

Rio Jamari

Rio Candeias

Ariquemnes

B R A Z I L

São Cruz

Rondônia

São João

Rio Branco

João Filipe

Uru-Eu-Wau-Wau Indigenous Area

0 10 20 Kilometers

N

Pacaás Novos National Park

19 Jun 1975

Tropical Forest

Rondônia, Brazil

Approximately 30 per cent of the world's tropical forests are found in Brazil. In a continuing effort to decentralize the Brazilian population and exploit undeveloped regions, the Brazilian

Credit: Ron Levy/UNEP/Topham

Primary land uses are cattle ranching and annual crop farming. More sustainable perennial crops like coffee and cacao occupy less than 10 per cent of the agricultural land areas.

government constructed the Cuiaba-Port Velho highway through the province of Rondônia. Completed in 1960, the road serves as the access route for infrastructural development in the region, previously occupied solely by indigenous people. In 1975, the region was still relatively pristine, with much of the forest intact. By 1989, the distinctive fishbone pattern of forest exploitation had appeared and by 2001 had expanded dramatically. The highway has become a major transportation route for immigrant farmers seeking income-producing opportunities. Migration into the area continues unabated.

Credit: David P. Shorthouse/UNEP/Forestry Images

Boreal forests cover large parts of Alaska, Canada, Scandinavia, and western Russia.

Oleniy Nat. Preserve

Val

Sea of Okhotsk

Nogliki

Katangli

Aleksandrovskiy Nat. Preserve

Nysh

Gorki

Gorki

Tatarskiy Proliv

0 10 20 Kilometres

N

17 Jun 1989

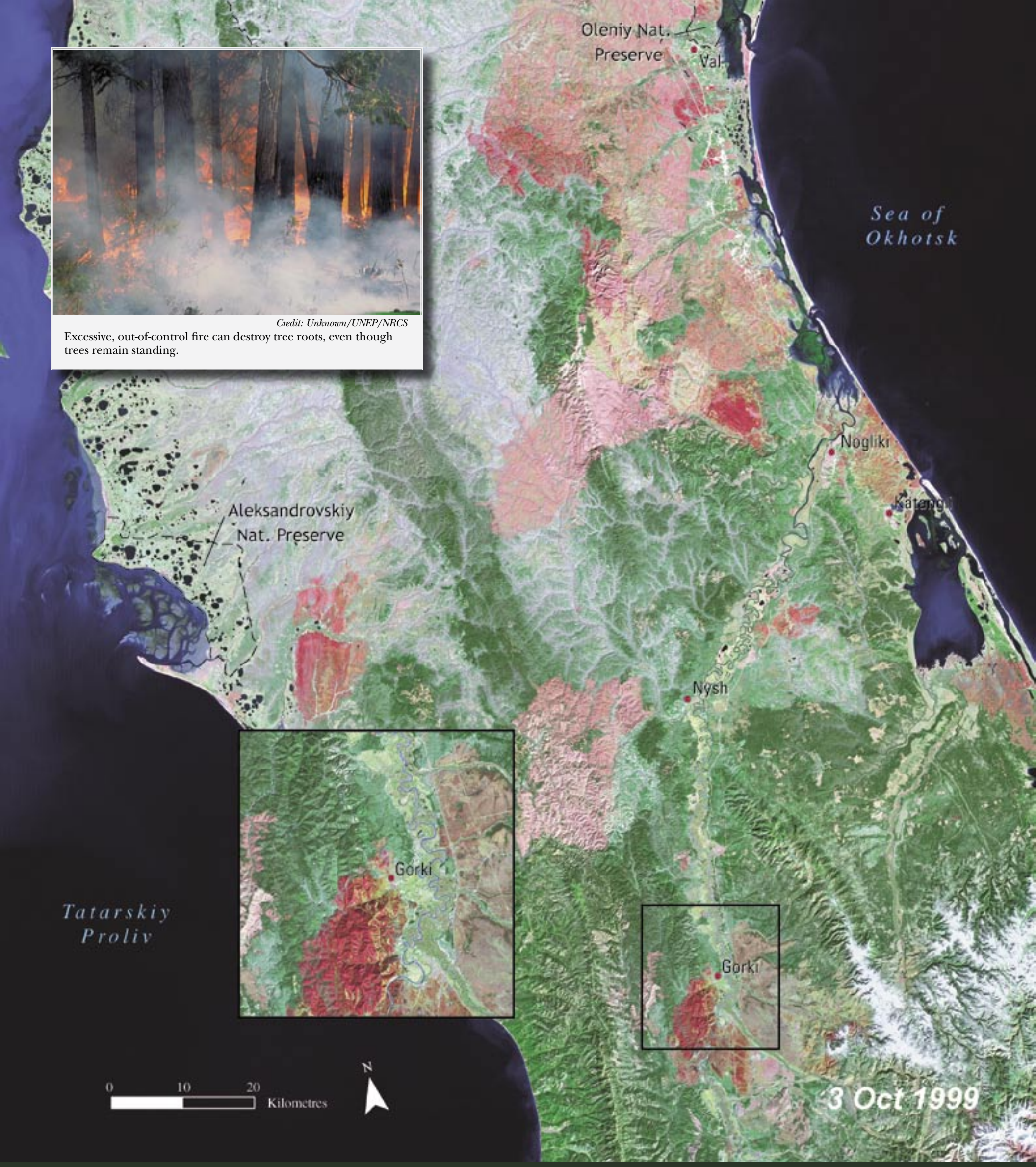
Boreal Forest

Sakhalin, Russia

Mixed deciduous and evergreen needle-leaf trees dominate the boreal forests of Sakhalin Island, just off the eastern coast of Russia. The tremendous natural reserves of the boreal forests serve as "carbon sinks" that help to regulate global climate. Boreal forests are also home to a unique collection of plants and animals, including rare and endangered species such

Credit: Unknown/UNEP/NRCS

Excessive, out-of-control fire can destroy tree roots, even though trees remain standing.



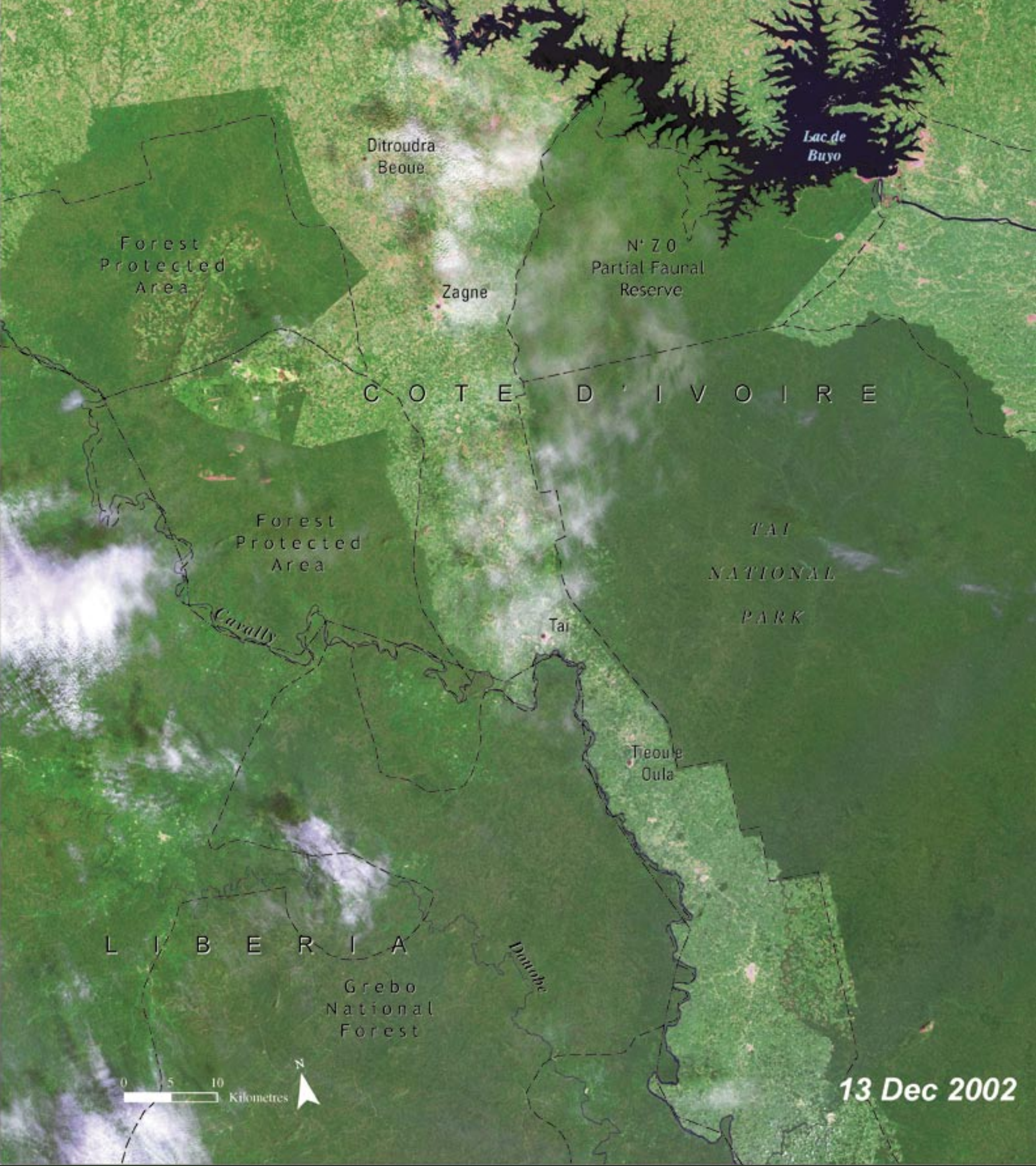
as the Amur Tiger. Fire is a natural and often vital component in maintaining the health of boreal forests. But since the 1950s, the frequency of fires has increased on Sakhalin Island as its forests have been subjected to rapid exploitation and disturbance in the acquisition of lumber, oil, coal, and peat. As people have moved into the region in greater numbers, the risk of fires started by trains, cars, trash fires, and wood stoves has increased greatly.

These satellite images show the impact of forest fires on Sakhalin Island. In 1998, roughly 300 intensely hot fires burned an area nearly the size of Luxembourg. Three people died and nearly 600 were made homeless by a very rapidly moving crown fire that consumed the town of Gorki within a few hours. The 1999 image very clearly shows the extent of the fire damage to the island's forests near the end of that year.

Ditroudra
Becue
Lac de
Buyo
Forest
Protected
Area
N° Z 0
Partial Faunal
Reserve
Zagne
C O T E D ' I V O I R E
Forest
Protected
Area
TAI
NATIONAL
PARK
Cavally
Tai
Tieoule
Oula
L I B E R I A
Dotobe
Grebo
National
Forest
0 5 10
Kilometres
9 Mar 1988

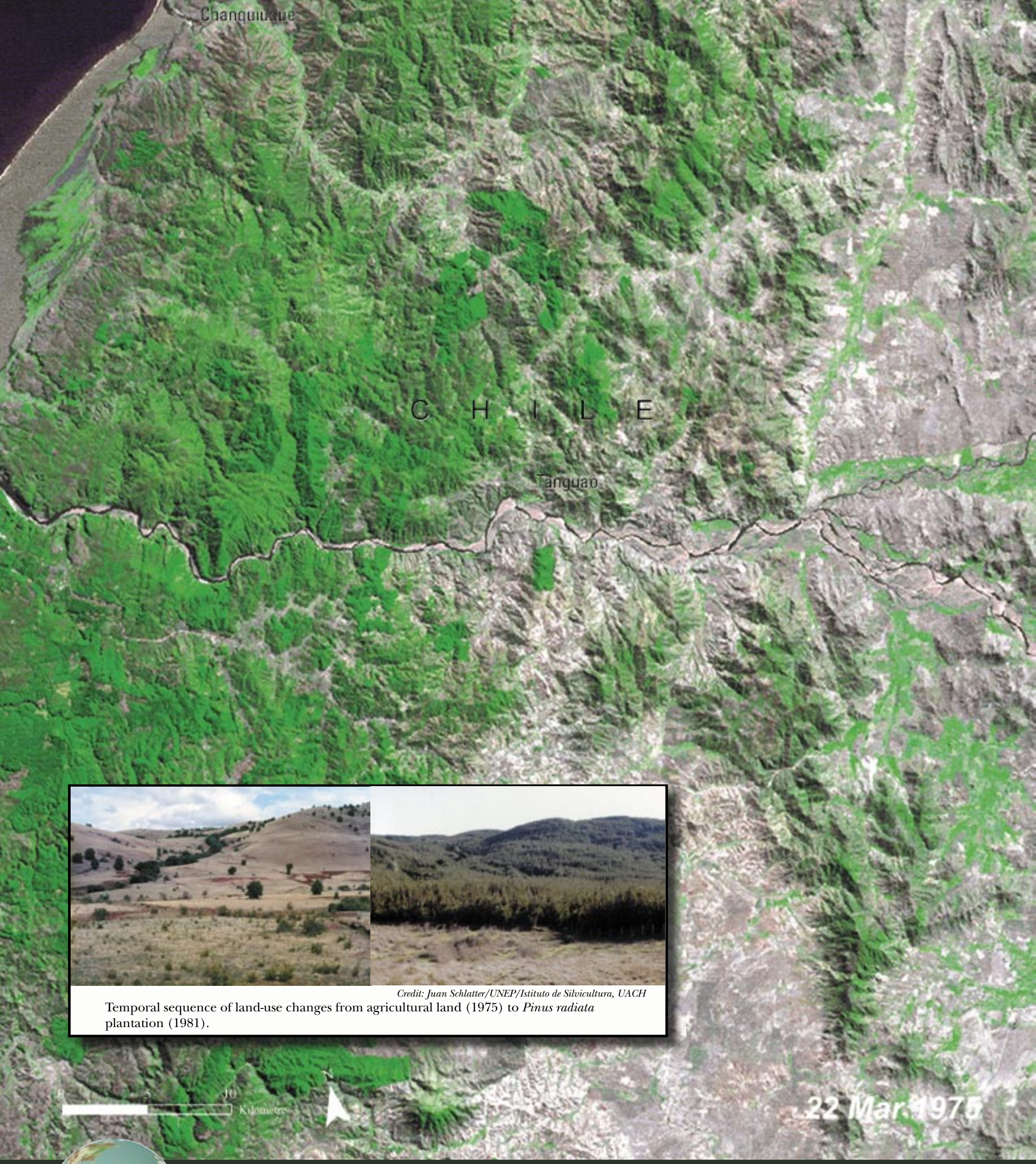
Tropical Forest
Tai National Park, Côte d'Ivoire

The deforestation rate in Côte d'Ivoire is thought to be one of the highest in tropical regions worldwide. Conservation of large forested areas, such as those within the boundaries of the Tai National Park, is



of primary importance, especially from a continental perspective. Conservation of smaller forested areas is also essential, both for biological conservation purposes and to meet the needs of rural communities.

A comparison of these satellite images from 1988 and 2002 shows the destruction of small forest fragments due to increased pressure from coffee and rubber plantations as well as their exploitation for fuel wood. The lighter green strip bisecting the images is the result of extensive deforestation and intensive cultivation between the protected Grebo National Forest and the Tai National Park. Encouragingly, the boundaries of the protected areas have remained relatively intact.



Credit: Juan Schlatter/UNEP/Istituto de Silvicultura, UACH

Temporal sequence of land-use changes from agricultural land (1975) to *Pinus radiata* plantation (1981).

Boreal Forest

Valdivian, Chile

Chile has been recently considered as one of the most economically competitive countries in Latin America. Rapid growth in Chile's production and export of forest products is based on the expansion and management of exotic species forest plantations in the last 30 years. However, some studies have demonstrated that such

Credit: Claudio Donoso/UNEP/Instituto de Silvicultura, UACH.

Mixed forest of native (*Nothofagus glauca*) and exotic (*Pinus radiata*) tree species.

expansion of forest plantation has produced a decrease in native forests in the south-central region of the country. These two Landsat, MSS and ETM scenes taken in 1975 and 2001, respectively, show changes in land use during the last 30 years. Many endangered tree and shrub species have been affected by this change, which has also led to a dramatic reduction of landscape diversity as well as goods and services from forestlands. The traditional land-use practices of small-scale logging of native forests, livestock and agriculture have been replaced by large-scale timber production that puts endemic endangered tree and shrub species at risk.